

FEATURES

- Evaluation board is designed to be used together with accompanying software to implement a fully functional energy meter (watt-hour meter)**
- Easy connection of various external transducers via screw terminals**
- Easy modification of signal conditioning components using PCB sockets**
- LED indicators on logic outputs CF, ZX, SAG, and IRQ**
- Optically isolated data output connection to PC parallel port**
- Optically isolated frequency output (CF) to BNC**
- External reference option available for on-chip reference evaluation**

GENERAL DESCRIPTION

The ADE7756 is a high accuracy electrical power measurement IC with a serial interface and pulse output. The ADE7756 incorporates two second-order Σ - Δ ADCs, reference circuitry, temperature sensor, and all the signal processing required to perform active power and energy measurement.

This data sheet describes the ADE7756 evaluation kit's hardware and software functionality. The ADE7756 evaluation board, together with the [ADE7756](#) data sheet and the EVAL-ADE7756EB data sheet, provides a complete evaluation platform for the ADE7756.

The evaluation board is designed so the ADE7756 can be evaluated in the end application, i.e., watt-hour meter. Using the appropriate transducers on the current channel, e.g., CT and shunt, the evaluation board can be connected to a test bench or high voltage (240 V rms) test circuit. An on-board resistor divider network provides the attenuation for the line voltage. This data sheet also describes how the current transducers should be connected for the best performance.

The evaluation board (watt-hour meter) is configured and calibrated via the parallel port of a PC. The data interface between the evaluation board and the PC is fully isolated. Windows® based software is provided with the evaluation board so it can be configured quickly as an energy meter.

The evaluation board also functions as a standalone evaluation system, which can be incorporated easily into an existing system via a 25-way D-Sub connector.

The evaluation board requires two external 5 V power supplies (one is required for isolation purposes) and the appropriate current transducer.

FUNCTIONAL BLOCK DIAGRAM

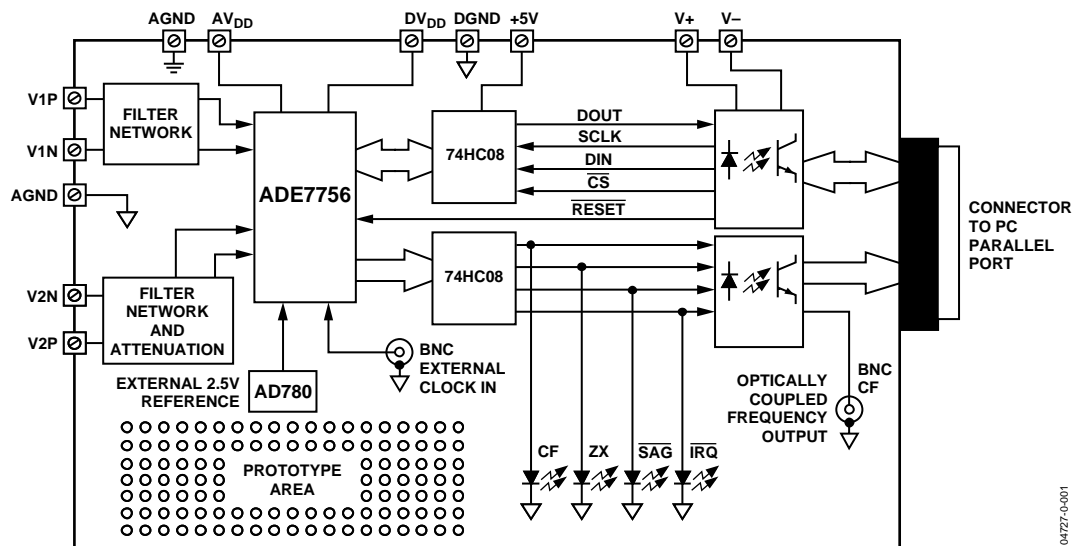


Figure 1.

Rev. 0

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REVISION HISTORY

4/04—Revision 0: Initial Version

ANALOG INPUTS (SK1 AND SK2)

Voltage and current signals are connected at the screw terminals SK1 and SK2, respectively. All analog input signals are filtered using the on-board antialiasing filters before being presented to the analog inputs of the ADE7756. The default component values, which are shipped with the evaluation board, are the recommended values for the ADE7756. Users can easily change these components; however, this is not recommended unless they are familiar with Σ - Δ converters and the criteria used for selecting the component values for the analog input filters. See Application Note AN-559 for a more comprehensive description of the antialiasing filters and their function.

CURRENT SENSE INPUTS (SK2)

SK2 is a 3-way connection block that allows the ADE7756 to be connected to a current transducer. Figure 2 shows the connector SK2 and the filtering network provided on the evaluation board.

The resistors SH1A and SH1B are by default not populated. They should be used as burden resistors when a CT is used as the current transducer (see the Using a CT as the Current Transducer section).

The RC networks R41/C11 and R42/C21 provide phase compensation when a shunt is used as the current transducer (see the Using the Shunt as the Current Transducer section). These RC networks are easily disabled by placing JP15 and JP25 and removing C11 and C21 (socketed).

The RC networks, R50/C50 and R51/C51, are the antialiasing filters required by the on-chip ADCs. The default corner frequency for these low-pass filters (LPF) is selected as 4.8 kHz (1 k Ω and 33 nF). These filters can easily be adjusted by replacing the components on the evaluation board. However, before adjusting the component values of R50, R51, C50, or C51, the user should first review Application Note AN-559.

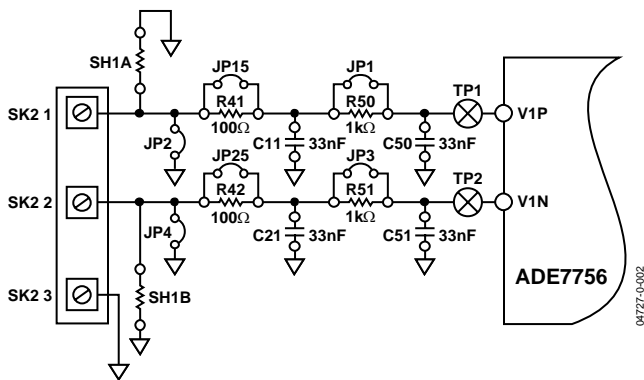


Figure 2. Current Channel on the ADE7756 Evaluation Board

USING A CT AS THE CURRENT TRANSDUCER

Figure 3 shows how a CT can be used as a current transducer in a signal-phase, 3-wire distribution system. This is how electrical energy is distributed to residential users in the United States. Phase A and Phase B are nominally 180° out of phase. The vector addition of the two currents is easily achieved by using two primary turns of opposite polarity on the CT.

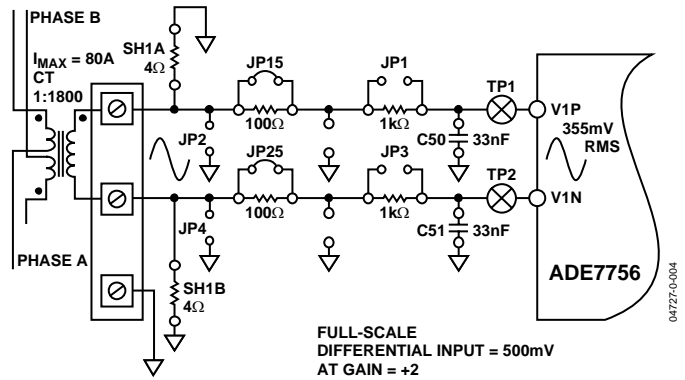


Figure 3. CT Connection to Current Channel

The CT secondary current is converted to a voltage by using a burden resistance across the secondary winding outputs. Care should be taken when using a CT as the current transducer. If the secondary is left open, i.e., no burden is connected, a large voltage could be present at the secondary outputs. This can cause an electrical shock hazard and potentially damage electronic components.

When using a CT as the current sensor, the phase compensation network for a shunt application should be disabled. This is achieved by closing Jumpers JP15/JP25 and removing C11/C21. The antialiasing filters should be enabled by opening Jumpers JP1/JP3 (see Figure 3).

Most CTs will have an associated phase shift of between 0.1° and 1° at 50 Hz/60 Hz. This phase shift or phase error can lead to significant energy measurement errors, especially at low power factors, see Application Note AN-559 for more information. However, this phase error can be corrected by writing to the phase calibration register (PHCAL) in the ADE7756. The software supplied with the ADE7756 evaluation board allows users to adjust the phase calibration register. See the Evaluation Software section for more information.

For this example, notice that the maximum analog input range on Channel 1 is set to 500 V, and the gain for Channel 1 has been set to 2. The maximum analog input range and gain are set via the gain register (GAIN). See the ADE7756 data sheet. The evaluation software allows users to configure the channel range and gain. The maximum peak differential signal on Channel 1 is 1 V.

USING A SHUNT RESISTOR AS THE CURRENT TRANSDUCER

Figure 4 shows how a shunt resistor can be used to perform the current-to-voltage conversion required for the ADE7756. A shunt is a cost-effective way to perform the current-to-voltage conversion in a 2-wire, single phase application. No isolation is required in a 2-wire application, and the shunt has advantages over the CT arrangement. For example, a shunt does not suffer from dc saturation problems, and the phase response of the shunt is linear over a very wide dynamic range. Although the shunt is predominately resistive, it does have parasitic reactive elements (inductance) that can become significant, even at 50 Hz/60 Hz. This means that there can be a small phase shift associated with the shunt. Once it is understood, the phase shift is easily compensated for with the filter network R41/C11 and R42/C21 (see Application Note AN-559 for more details).

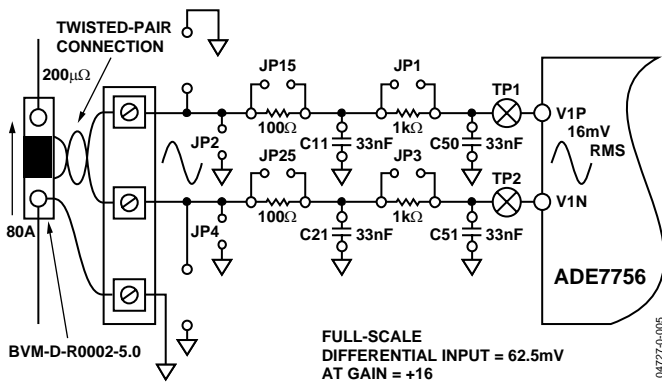


Figure 4. Shunt Connection to Current Channel

The shunt used in this example is a 200 µΩ Manganin® type. The resistance of the shunt should be as low as possible in order to avoid excessive power dissipation in the shunt. Although the shunt is fabricated from a special alloy (Manganin), which has a very low temperature coefficient of resistance, excessive heating due to power dissipation can cause measurement inaccuracies when operating at heavy loads over extended periods of time.

The Manganin shunt used in this example (BVM-DR0002-5.0) is designed specifically for energy metering applications and is supplied by Isotek Corp.

This shunt is PCB mountable with a current carrying ability of 70 A rms. The technical data supplied by Isotek Corp. gives detailed information regarding PCB layout. Figure 4 shows how the shunt can be connected to the evaluation board. Two sense wires should be soldered to the shunt as shown at the copper/manganin junctions. These sense wires should be formed into a twisted pair to reduce the loop area that reduces antenna effects. A connection for the common-mode voltage can be made at the connection point for the current carrying conductor (see Figure 4).

VOLTAGE SENSE INPUTS

The voltage input connections on the ADE7756 evaluation board can be directly connected to the line voltage source. The line voltage is attenuated using a simple resistor divider network before it is presented to the ADE7756. Because of the relatively large signal on this channel and the small dynamic range requirement, the voltage channel can be configured in a single-ended configuration. Figure 5 shows a typical connection for the line voltage.

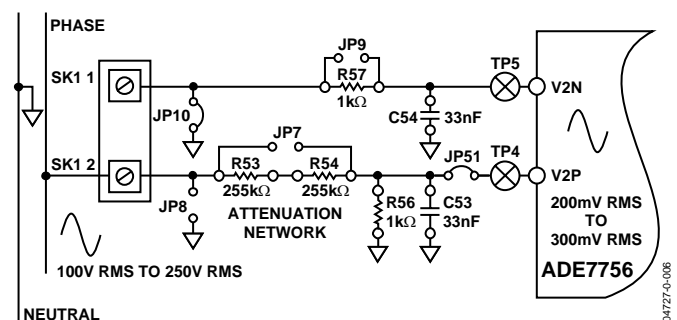


Figure 5. Voltage Channel on the ADE7756 Evaluation Board

Note that the analog input V2N is connected to AGND via the antialiasing filter R57/C54 using JP10. Jumper JP9 should be left open.

The voltage attenuation network is made up of R53, R54, and R56. The maximum signal level permissible at V2P is 1 V peak. Although the ADE7756 analog inputs can withstand ±6 V without risk of permanent damage, the signal range should not exceed ±1 V, with respect to AGND, for specified operation.

The attenuation network can be easily modified by the user to accommodate any input signal levels. However, the value of R56 (1 kΩ) should not be altered as the phase response of Channel 2 should match the phase response of Channel 1 (see Application Note AN-559).

JUMPER SETTINGS

Table 1.

Jumper	Option	Description
JP1	Closed	This shorts out R50. The effect is to disable the antialiasing filter on the analog input V1P. Default open.
	Open	Enable the antialiasing filter on V1P.
JP2	Closed	This connects the analog input V1P to ground. Default open.
JP3	Closed	This shorts out R51. The effect is to disable the antialiasing filter on the analog input V1N. Default open.
	Open	Enable the antialiasing filter on V1N.
JP4	Closed	This connects the analog input V1N to ground. Default open.
JP5	A	This connects the buffered logic output \overline{IRQ} to the LED1.
	B	This connects the buffered logic output \overline{IRQ} to Pin 10 on the D-Sub connector via an optical isolator.
JP6	A	This connects the buffered logic output \overline{SAG} to the LED2.
	B	This connects the buffered logic output \overline{SAG} to Pin 11 on the D-Sub connector via an optical isolator.
JP7	Closed	This shorts the attenuation network on Channel 2. Default open.
JP8	Closed	This connects the analog input V2P to ground. Default open.
JP9	Closed	This shorts out R57. The effect is to disable the antialiasing filter on the analog input V2N. Default open.
	Open	Enable the antialiasing filter on V2N.
JP10	Closed	This connects the analog input V2N to ground. Default open.
JP11	Closed	This connects the analog and digital ground planes of the PCB. Default closed.
JP12	A	This connects the buffered logic output CF to the LED4.
	B	This connects the buffered logic output CF to the BNC2 connector via an optical isolator.
JP13	Closed	This connects an external reference 2.5 V (AD780) to the ADE7756.
	Open	This enables the ADE7756 on-chip reference.
JP14	Closed	This connects the optical isolator ground to the evaluation board ground (DGND). If full isolation between the evaluation board and PC is required, this jumper should be left open.
JP15	Closed	This shorts out R41. The effect is to disable the phase compensation filter (for shunts) on the analog input V1P. Default closed.
JP19	A	This connects the buffered logic output ZX to the LED3.
	B	This connects the buffered logic output ZX to Pin 12 on the D-Sub connector via an optical isolator.
JP20	Closed	This connects the AVDD and DVDD supply for the evaluation board together. Default closed.
JP21	Closed	This connects the DVDD and 5 V (buffers) supply for the evaluation board together. Default closed.
JP25	Closed	This shorts out R42. The effect is to disable the phase compensation filter (for shunts) on the analog input V1N. Default closed.
JP51	Closed	This shorts out/disconnects analog input V2P from the ADE7756. Default closed.

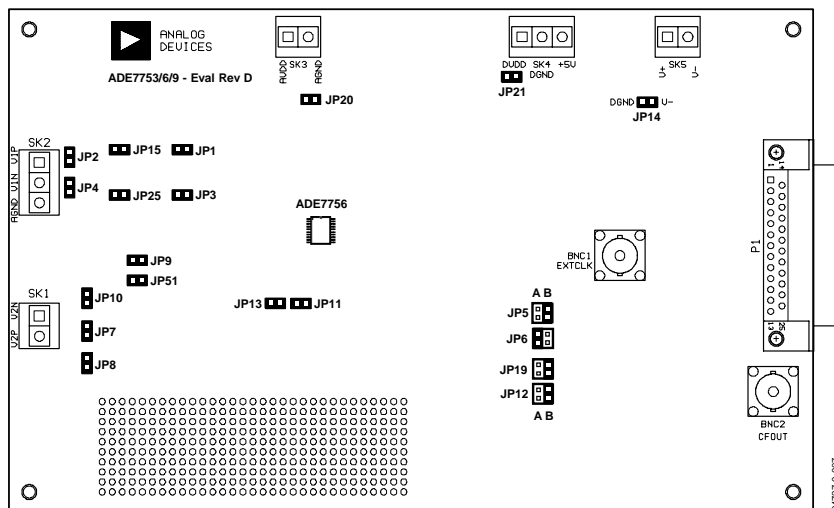


Figure 6. ADE7756 Evaluation Board Jumper Positions

SETTING UP THE ADE7756 EVALUATION BOARD

Figure 7 shows a typical setup for the ADE7756 evaluation board. In this example, a kWh meter for a 3-wire, single phase distribution system is shown. For a more detailed description on how to use a CT as a current transducer, see the Current Sense Inputs (SK2) section. The line voltage is connected directly to the evaluation board, as shown in Figure 7. Note JP7 should be left open to ensure that the attenuation network is not bypassed, and also note the use of two power supplies. The second power supply is used to power the optical isolation. With JP14 left open, there is no electrical connection between the high voltage test circuit and the PC. The power supplies should have floating voltage outputs.

The evaluation board is connected to the PC parallel port using the cable supplied. The cable length should not exceed 6 feet (2 meters) or the serial communication between the PC and the evaluation board may become unpredictable and error prone.

When the evaluation board has been powered up and is connected to the PC, the supplied software can be launched. The software automatically starts in energy meter mode. The next section describes how the ADE7756 evaluation software can be installed and removed.

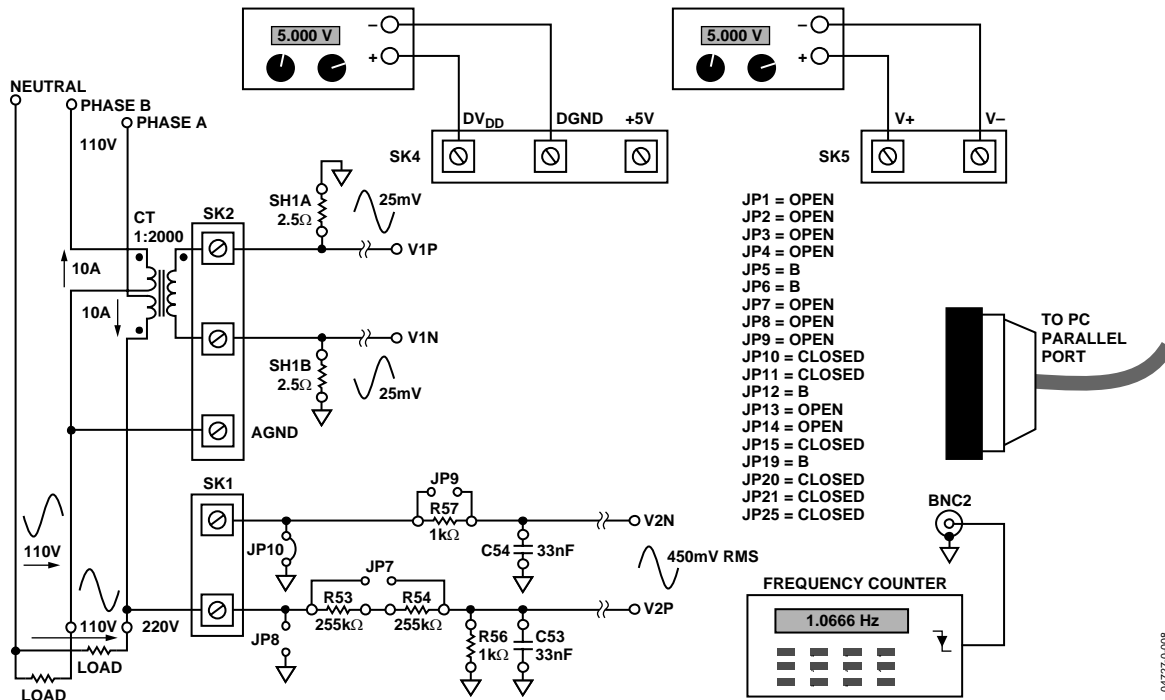


Figure 7. Typical Setup for the ADE7756 Evaluation Board

EVALUATION SOFTWARE

The ADE7756 evaluation board is supported by Windows based software that allows users to access all the functionality of the ADE7756. The software is designed to communicate with the ADE7756 evaluation board via the parallel port of the PC.

INSTALLING THE ADE7756 SOFTWARE

The ADE7756 software is supplied on three 3.5-inch 1.44 MB floppy disks. The minimum requirements for the PC are Pentium® II 233 MHz processor, 32 MB RAM, 10 MB free HD space, and at least one PS/2 or ECP parallel port. To install the software, place disk No. 1 in the floppy drive and double-click setup.exe. This launches the setup program that automatically installs all the software components, including the uninstall program, and creates the required directories. When the setup program has finished installing the ADE7756Eval program, users are prompted to install National Instruments' run-time engine. This software was developed using National Instruments' LabVIEW™ software, and the run-time engine is required to run the ADE7756eval program. When prompted, take disk No. 1 out of the floppy drive, insert disk No. 2, and hit Enter. Users should follow the on-screen instructions and reboot their computers to complete the installation. To launch the software, select Start—>Programs—>ADE7756 menu and click on ADE7756eval.

REMOVING THE ADE7756 EVALUATION SOFTWARE

Both the ADE7756Eval program and National Instruments' run-time engine are easily removed by using the Add or Remove Programs feature in the Control Panel. Select Start—>Control Panel—>Add or Remove Programs, and click the program to remove it.

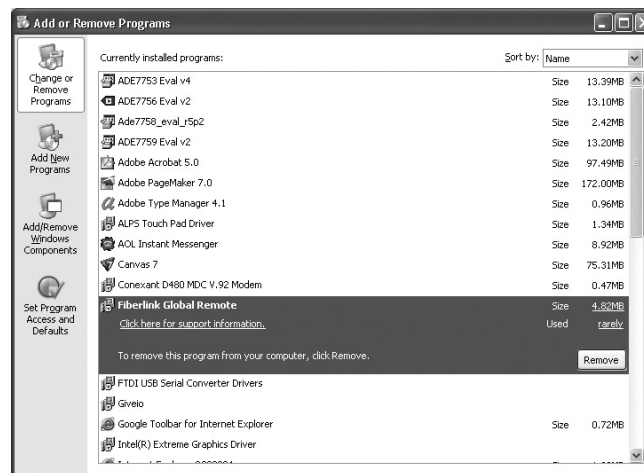


Figure 8. Removing the ADE7756 Evaluation Software

EVAL-ADE7756EB

METER MODE

When the software is launched, the program automatically starts meter mode. In this mode, the evaluation board can be used as a fully functional energy meter. When the appropriate line voltage, test current, frequency, and meter constant have been set up, the calibration routine can be used to remove any error associated with the transducers. The CF output can be used with a standard frequency counter to check the accuracy. The measured CF output frequency should be adjusted to match the theoretical CF frequency of the evaluation software.

Note that the calibration routine does not automatically remove phase errors associated with a CT or other transducer. These must be removed first by using the ADE7756 PHCAL Register.

Instantaneous power, voltage, and current rms calculations are also available in this window. They are processed using the waveform sampling routine with the number of samples defined in this mode.

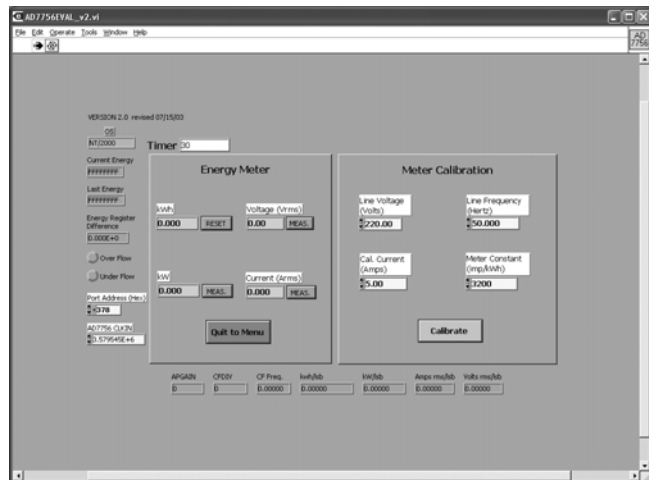


Figure 9. Meter Mode

Note also that the input signal range and gain must be set for the PGAs on Channel 1 and Channel 2. This ensures that the output signal range from the transducers is matched to the analog inputs. For example, in the meter example shown in Figure 9 the line voltage is attenuated to approximately 215 mV rms or 300 mV peak. By selecting a gain of 2 for the PGA in Channel 2, the peak differential input signal is set to 500 mV. Similarly as an example for Channel 1, assuming a maximum current of 120 A, the maximum differential output signal from the CT is 300 mV. Therefore, the full-scale differential input signal level is set to 500 mV by setting the gain to 2 (see Table I in the ADE7756 data sheet). The PGA settings are made through the main Selection Menu. To get to the main selection menu, click the Quit to Menu button at any time.

CALIBRATING THE METER

In order to calibrate the energy meter, the line voltage, test current, line frequency, and meter constant must be entered, as shown in Figure 9. In this example, the line voltage is 220 V, the test current is 5 A, the frequency is 50 Hz, and the required meter constant is 3,200 imp/kWh. Once the parameters are entered and the voltage and current circuits are energized, click the Calibrate button. The software then executes the calibration routine and automatically starts to register energy.

If a HP/AGILENT53131A frequency counter is connected to a GPIB card on the PC, the software will automatically read the value of the CF frequency and process the calibration routine. In this case, the calibration takes about 5 seconds and the user is notified when it is complete.

Otherwise, calibration can be preceded by changing CFDIV and APGAIN registers, which is explained in the ADE7756 data sheet. The measured CF output frequency is then adjusted to match the theoretical CF frequency of the evaluation software.

Ensure that the analog input signal levels have been matched to the transducer output signal levels, as described.

MAIN SELECTION TABLE

In order to access all the internal registers of the ADE7756, users must return to the main Selection Menu. Figure 10 shows the main Selection Menu and the various options. From here such things as phase compensation and Channel 1 and Channel 2 PGA settings can be made.

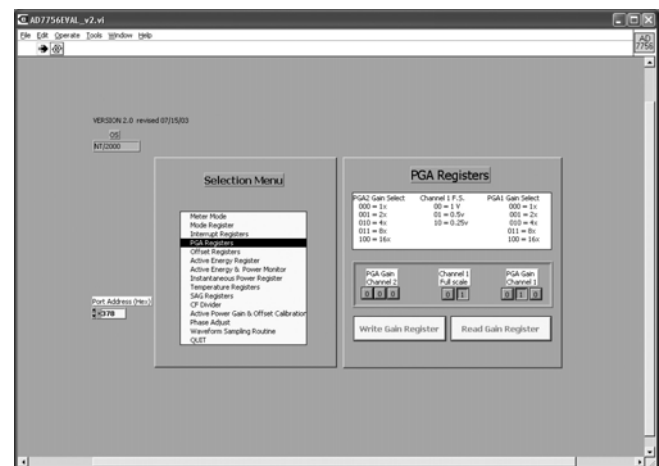


Figure 10. Selection Menu and PGA Settings

To select another option from the menu, simply click on the Selection Menu. By using the Selection Menu, users can read and write to the registers of the ADE7756. This software should be used in conjunction with the ADE7756 data sheet.

WAVEFORM SAMPLING ROUTINE

In this mode, the evaluation software programs the ADE7756 for waveform sampling with an updated rate of 3.5 kSPS (CLKIN/1024). The user can define the number of samples needed and select the signal waveform to transfer. Three parameters are processed when the waveform is displayed: rms value, mean value, and standard deviation.

When using this feature with sine wave signals, users should be aware that if the samples represent a noninteger number of periods of the selected signal, then the rms and mean values are biased. To correct this, the number of samples should be chosen to give an entire number of signal cycles as follows:

$$\text{No. of Samples} = \frac{\text{No. of Signal Cycles} \times \text{ADE7756 CLKIN Frequency}}{1024 \times \text{Signal Frequency}}$$

Note that if Channel 1 and Channel 2 are at the same frequency, then the signal frequency of the multiplier waveform should be chosen as twice the Channel 1 frequency to correct the signal processing bias.

ONLINE HELP

The ADE7756 evaluation software also comes with an online help feature. Select Help → Show Help from the menu (see Figure 11). A Help Window opens. For a description of a particular option, e.g., button or text box, move the cursor over the item. The Help window displays a description of the item.

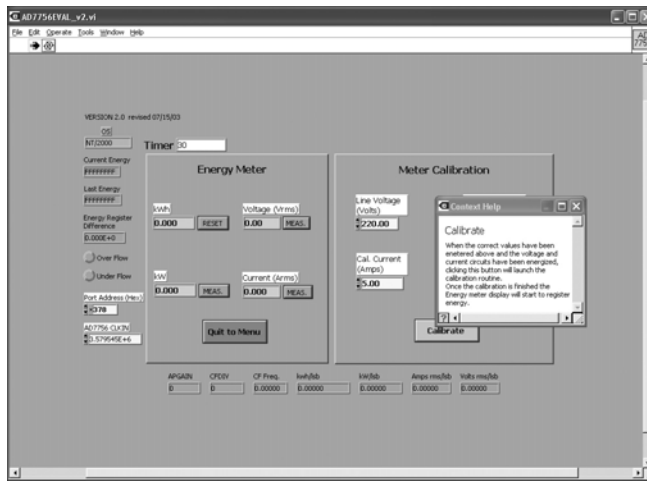


Figure 11. Online Help Function

MEASURING CT PHASE ERRORS USING THE ADE7756

The ADE7756 can measure a CT (and external components) phase error during calibration. The assumption is that the ADE7756 has no internal phase error (PHCAL = 00 hex), and the error due to external components is small (<0.5°). The procedure is based on a 2-point measurement at PF = 1 and PF = 0.5 (lag). The PF is set up using the test bench source, and this source must be very accurate. The ADE7756 should be configured for energy measurement mode.

An energy measurement is first made with PF = 1 (Measurement A). A second energy measurement should be made at PF = 0.5 (Measurement B). The frequency output CF can be used for this measurement. Using the following formula, the phase error is easily calculated:

$$\text{Phase Error } (^\circ) = \tan^{-1} \left(\frac{B - A/2}{A/2 \times \sqrt{3}} \right)$$

For example, using the frequency output CF to measure power, a frequency of 3.66621 Hz is recorded for PF = 1. The PF is then set to 0.5 lag and a measurement of 1.83817 Hz is obtained. Using the formula above, the phase error on Channel 1 is calculated as

$$\text{Phase Error } (^\circ) = \tan^{-1} \left(\frac{1.83817 - 3.66621/2}{3.66621/2 \times \sqrt{3}} \right) = 0.091^\circ$$

The formula also gives the correct sign for the phase error. In this example, the phase error is calculated as 0.091° at the input to Channel 1 of the ADE7756. This means that the CT has introduced a phase lead of 0.091°. Therefore, the phase difference at the input to Channel 1 is now 59.89° lag instead of 60° lag. Determining whether the error is a lead or lag can also be figured intuitively from the frequency output. Figure 12 shows how the output frequency varies with phase (cos {Φ}). Since the Output Frequency B (1.83817 Hz) at the PF = 0.5 lag setting in the example is actually greater than A/2 (1.833105 Hz), the phase error between Channel 1 and Channel 2 is actually less than 60°. This means there is additional lead in Channel 1 due to the CT.

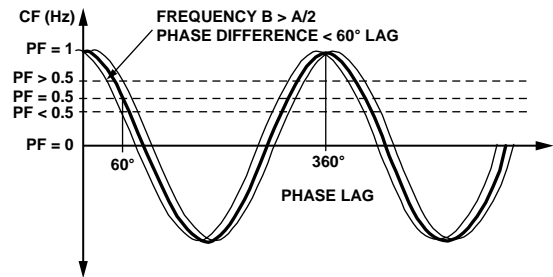


Figure 12. CF Frequency vs. Phase (PF)

USING PHASE CALIBRATION TO CORRECT SMALL (<0.5°) EXTERNAL PHASE ERRORS

From the previous example, it is seen that the CT introduced a phase lead in Channel 1 of 0.091°. Therefore, instead of a 60° phase difference between Channel 1 and Channel 2, it is actually 59.89°. In order to bring the phase difference back to 60°, the phase compensation circuit in Channel 2 is used to introduce an extra lead of 0.091°. This is achieved by reducing the amount of time delay in Channel 2.

The maximum time delay adjustment in Channel 2 is $\pm 143 \mu\text{s}$ with a CLKIN of 3.579545 MHz. The PHCAL register is a signed twos complement 6-bit register. Therefore, each LSB is equivalent to 4.47 μs . In this example, the line frequency is 50 Hz. This means each LSB is equivalent to $360^\circ \times 4.47 \mu\text{s} \times 50 = 0.08^\circ$. To introduce a lead of 0.091°, the delay in Channel 2 must be reduced. This is achieved by writing -5 (FFh) or +0.08° to the PHCAL register.

CORRECTING LARGE EXTERNAL PHASE ERRORS

In this example, the phase correction range at 50 Hz is approximately $\pm 2.5^\circ$. However, it is best to use the PHCAL register only for small phase corrections, i.e., $< 0.5^\circ$. If larger corrections are required, the larger part of the correction can be made using an external passive component. For example, the resistors in the antialiasing filter can be modified to shift the corner frequency of the filter to introduce more or less lag. The lag through the antialiasing filters with 1 k Ω and 33 nF is 0.56° at 50 Hz. Fine adjustment can be made with the PHCAL register. Note that typically CT phase shift does not vary significantly from part to part. If a CT phase shift is 1°, then the part-to-part variation should only be about $\pm 0.1^\circ$. Therefore, the bulk of the phase shift (1°) can be canceled with fixed component values at design. The remaining small adjustments can be made in production using the PHCAL register.

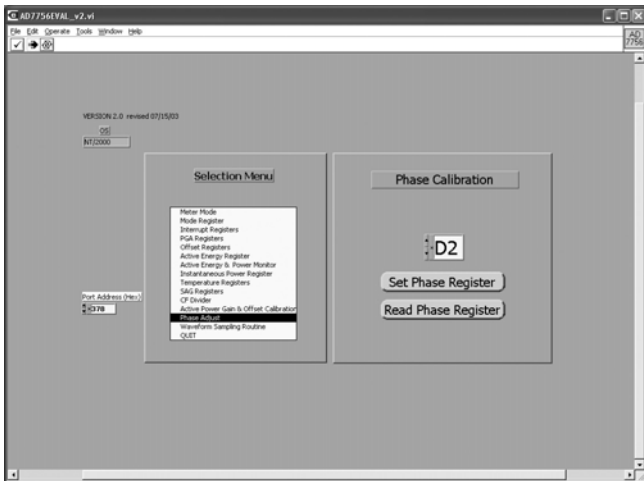


Figure 13. Writing to the PHCAL Register to Correct Phase Error

EVALUATION BOARD BILL OF MATERIALS

Table 2.

Designator	Value	Description
R3, R5, R6, R13, R22, R30, R31, R33, R34, R37	100 Ω , 5%, ¼ Ω	Resistor, No Special Requirements.
R2, R7 to R10, R39, R40	10 k Ω , 5%, ¼ Ω	Resistor, No Special Requirements.
R1, R14 to R27, R36	820 Ω , 5%, ¼ Ω	Resistor, No Special Requirements.
R50, R51, R52, R57	1 k Ω , 0.1%, ¼ Ω	± 15 ppm/ $^{\circ}$ C Resistor, Good Tolerance, Used as Part of the Analog Filter Network. These resistors are not soldered but are plugged into the PCB pin sockets for easy modification by the customer. Low drift Welwyn RC55 Series, Farnell Part No. 339-179.
R53, R54	255 k Ω , 0.1%, ¼ Ω	Pin Socketed, ± 15 ppm/ $^{\circ}$ C Low Drift, Welwyn RC55 Series, Farnell Part No. 338-484.
R41, R42	100 Ω , 0.1%, ¼ Ω	± 15 ppm/ $^{\circ}$ C Resistor, Good Tolerance. Low drift Farnell Part No. 338-217.
R11	51 Ω , 1%, ¼ Ω	Not Populated, Pin Socket to Be Used with External 50 Ω Clock Source.
R4	0 Ω , 10%, ¼ Ω	
C5, C7, C24, C28, C30	10 μ F, 10 V dc	Power Supply Decoupling Capacitors, 20%, AVX-Kyocera, Farnell Part No. 643-579.
C14, C15	22 pF, Ceramic	Gate Oscillator Load Capacitors, Farnell Part No. 108-927.
C6, C8, C23, C25, C27, C29, C31 to C36	100 nF, 50 V	Power Supply Decoupling Capacitors, 10%, X7R type, AVX-Kyocera, Farnell Part No. 108-946.
C16	220 pF	AVX-Kyocera, Farnell Part No. 108-946.
C11, C21, C50, C51, C53, C54	33 nF, 10%, 50 V	X7R Capacitor, Part of the Filter Network. These resistors are not soldered but are plugged into the PCB mount sockets for easy modification by the customer. The SR15 series AVX-Kyocera, Farnell Part No. 108-948.
U1	ADE7756AN	Supplied by Analog Devices, Inc.
U2, U3	74HC08	Quad CMOS AND Gates.
U4	AD780	2.5 V Reference, Supplied by Analog Devices, Inc.
U5, U7 to U9	HCPL2232	HP Optical Isolator, Newark Part No. 06F5434.
U6	HCPL2211	HP Optical Isolator, Newark Part No. 06F5428.
LED1 to LED4	LED	Low Current, Red, Farnell Part No. 637-087.
XTAL	3.579545 MHz	Quartz Crystal, HC-49 (US), ECS Part No. ECS-35-17-4. Digi-Key Part No. X079-ND.
SK1, SK3, SK5	Screw Terminal	15 A, 2.5 mm Cable Screw Terminal Sockets. Farnell Part No. 151-785, Length 10 mm, Pitch 5 mm, Pin Diameter 1 mm.
SK2, SK4	Screw Terminal	15 A, 2.5 mm Cable Screw Terminal Sockets. Farnell Part No. 151-786, Length 15 mm, Pitch 5 mm, Pin Diameter 1 mm.
BNC1, BNC2	BNC Connector	Straight Square, 1.3 mm Holes, 10.2 mm \times 10.2 mm, Farnell Part No. 149-453.
P1	D-Sub 25-Way Male	AMP 747238-4, Right Angle, D-Sub, 8 mm PCB Mount, Digi-Key Part No. 747238-4.
TP4 to TP14	Test Point Loop	Test Point Loop, Compnt Corp. TP-104-01-XX.
JP1 to JP4, JP7 to JP11, JP13 to JP15, JP20, JP21, JP25, JP51	2-Pin Header	2-Pin, 0.025 Sq., 0.01 Ctrs, Compnt Corp., CSS-02-02.
JP5, JP6, JP12, JP19	2-Pin Header \times 2	2-Pin, 0.025 Sq., 0.01 Ctrs, Compnt Corp., CSS-02-02.
Pin Sockets	DIL	Sockets for U1 to U9, 0.022" to 0.025" Pin Diameter, ADI Stock 12-18-33. Advance KSS100-85TG.
Pin Sockets	Discretes	R11, R41, R42, R50 to R54, R57, C11, C21, C50 to C54. ADI Stock 12-18-41.

EVALUATION BOARD SCHEMATIC (REV. D AND REV. E)

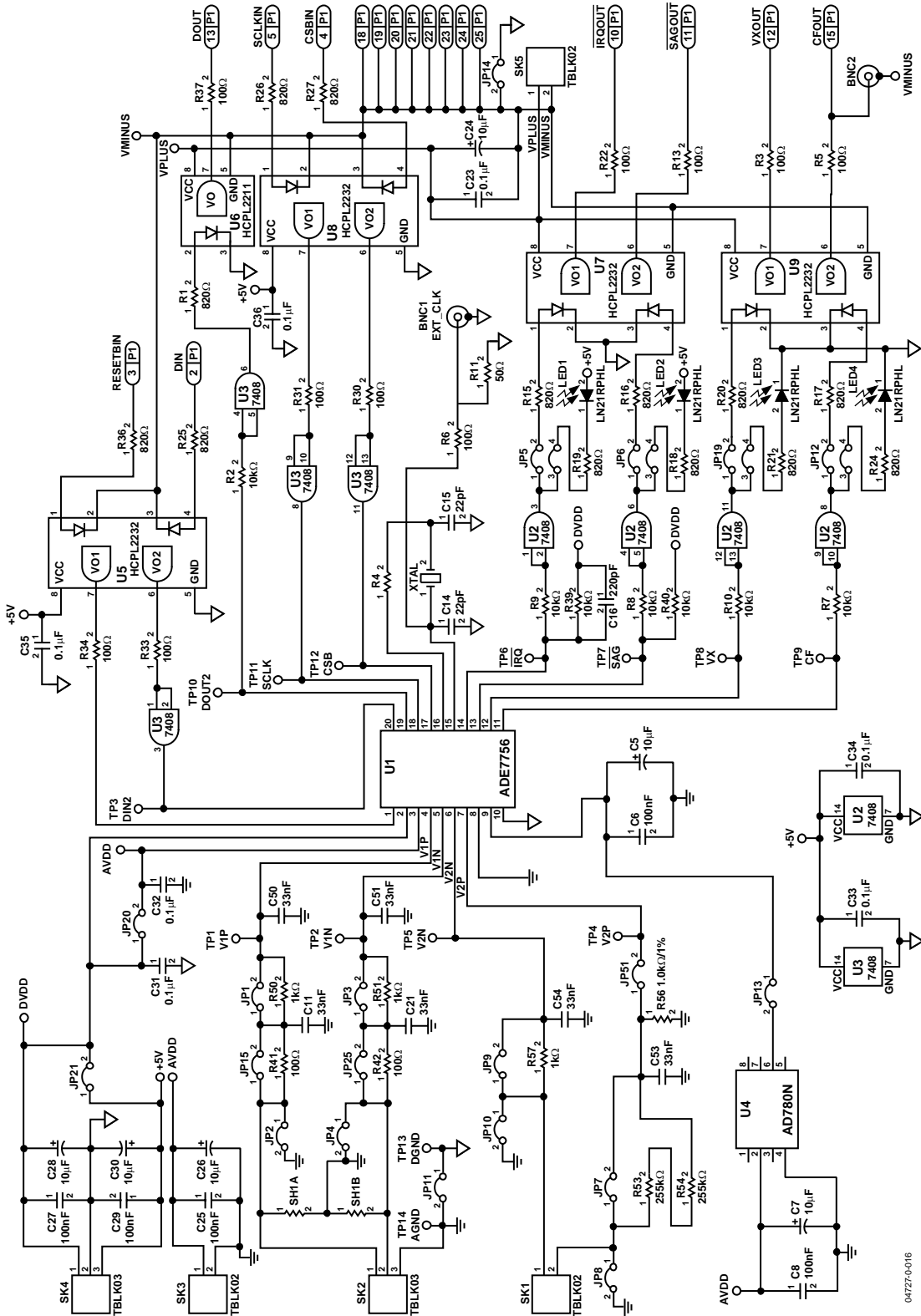


Figure 14. Evaluation Board Schematic

04727-0-016

PCB LAYOUT—COMPONENT PLACEMENT (REV. D)

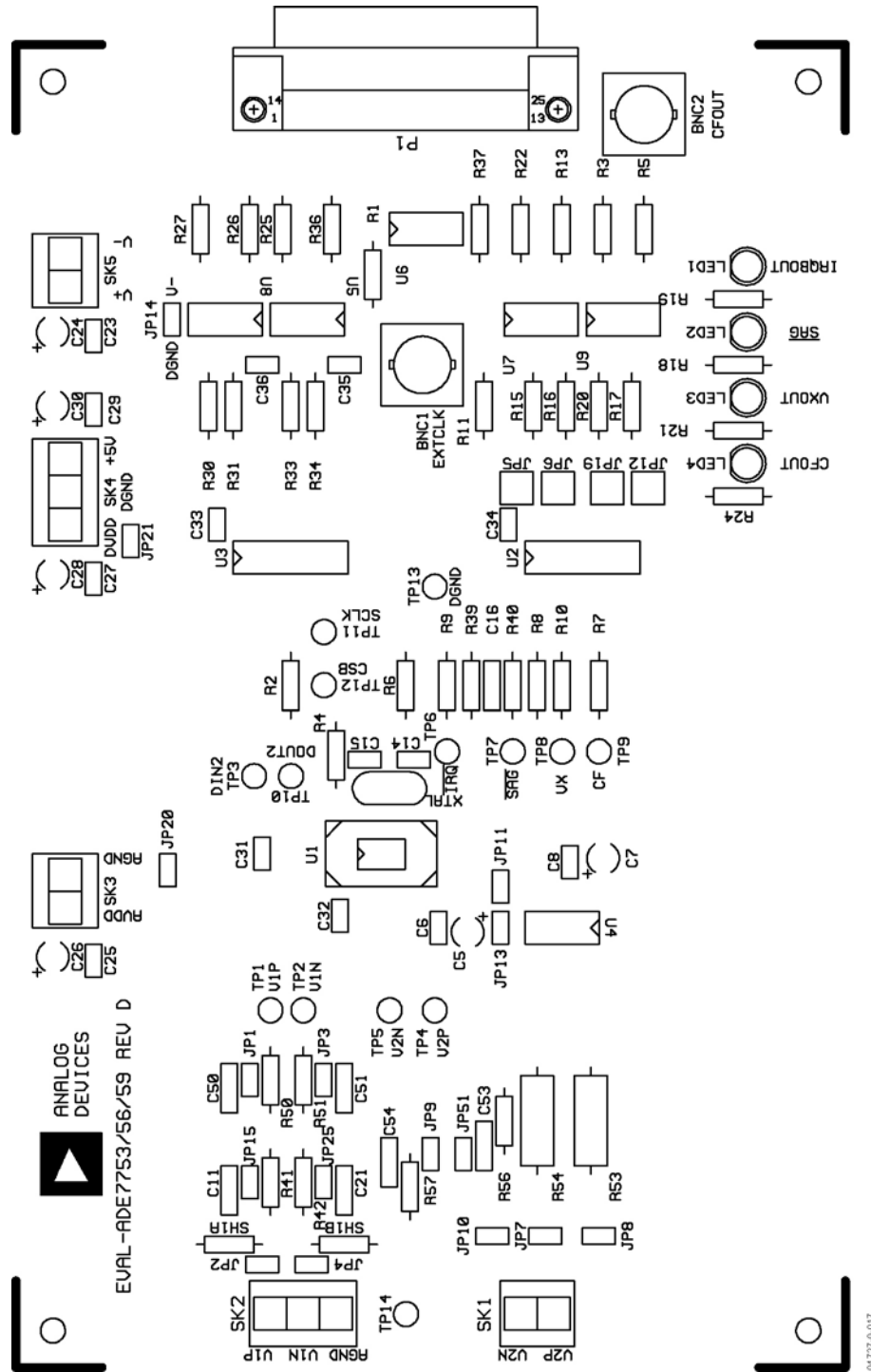


Figure 15. PCB Layout—Component Placement

PCB LAYOUT—COMPONENT SIDE (REV. D)

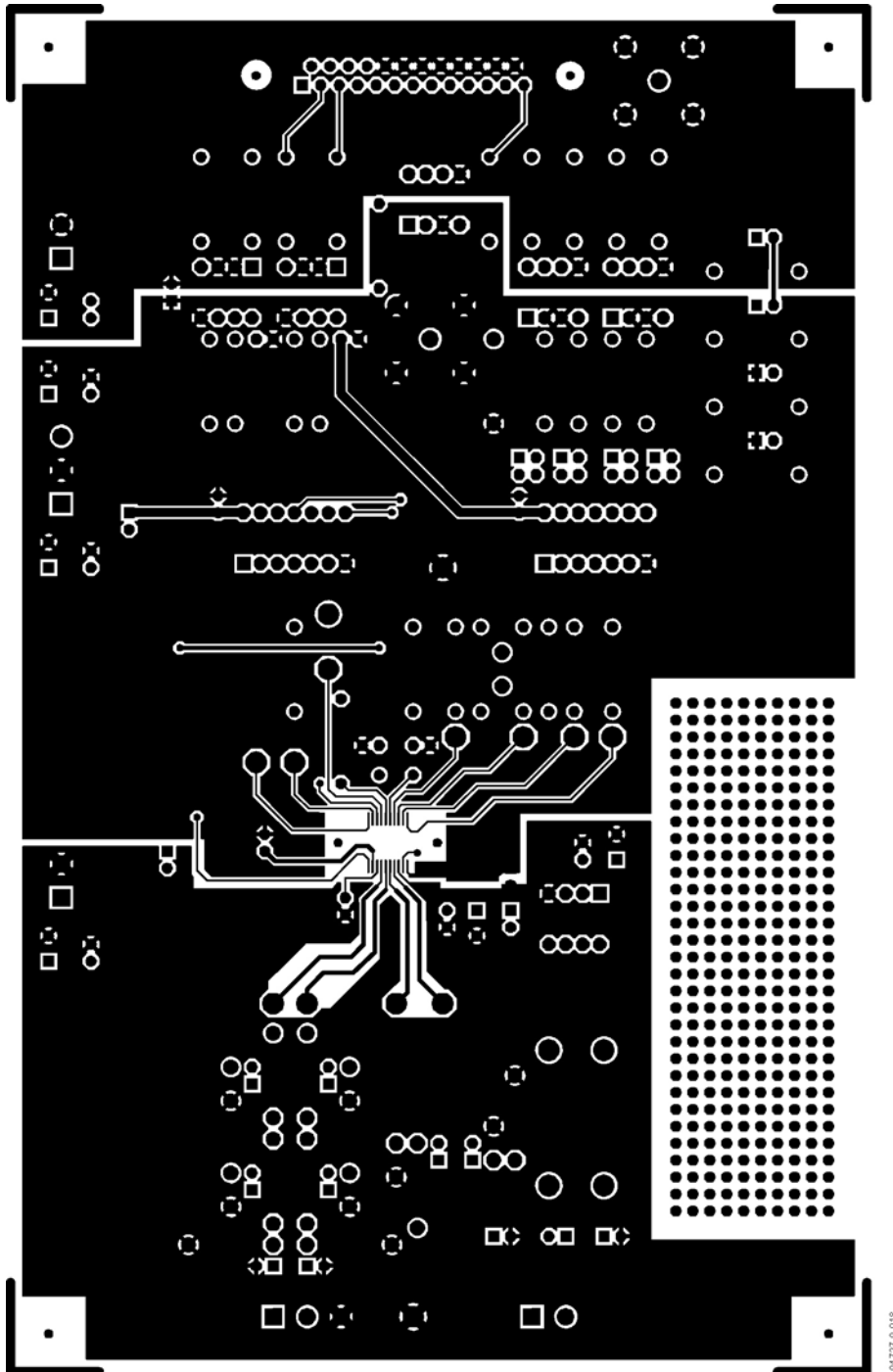


Figure 16. PCB Layout—Component Side

PCB LAYOUT—SOLDER SIDE (REV. D)

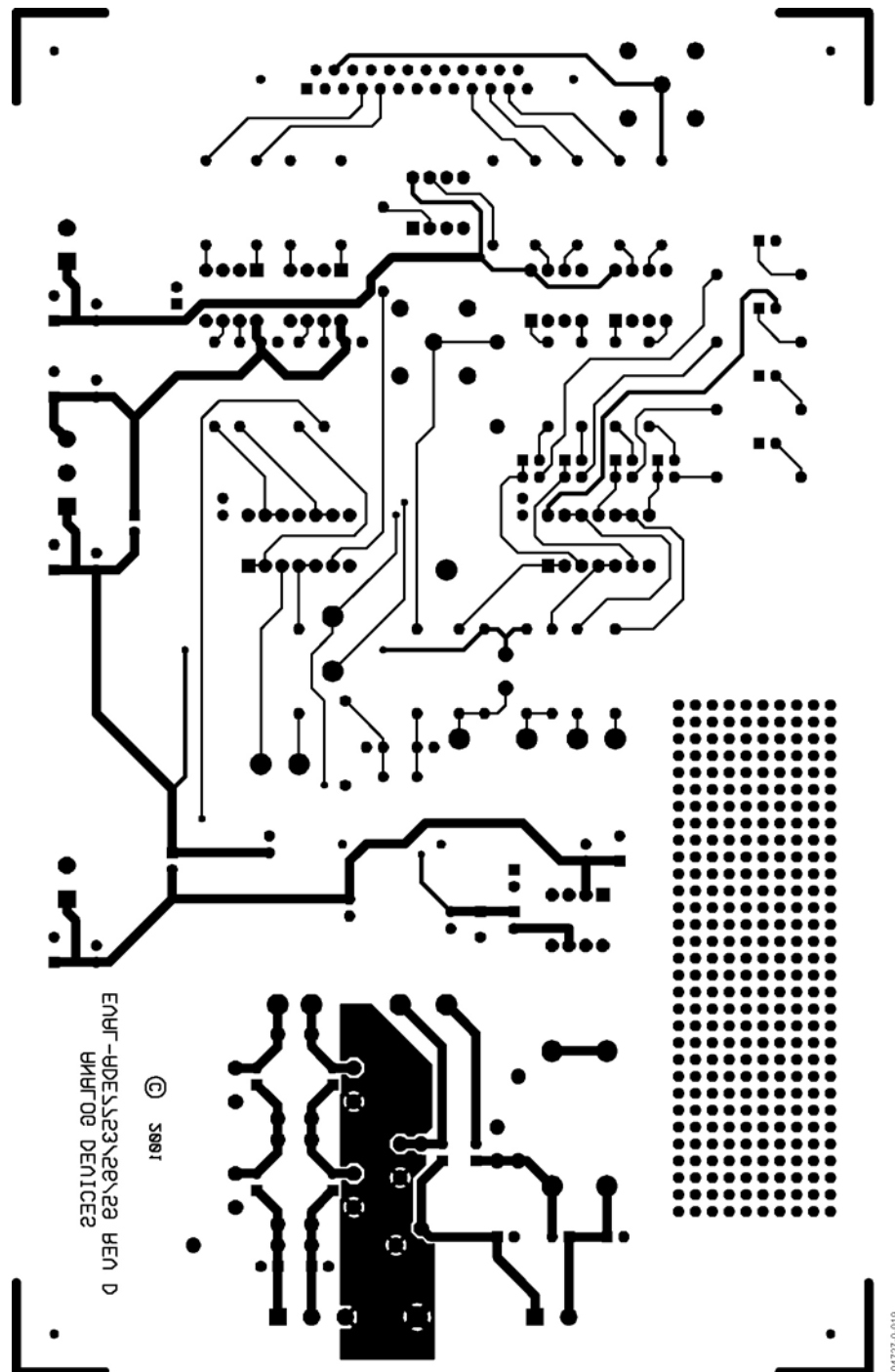


Figure 17. PCB Layout—Solder Side

PCB LAYOUT—COMPONENT PLACEMENT (REV. E)

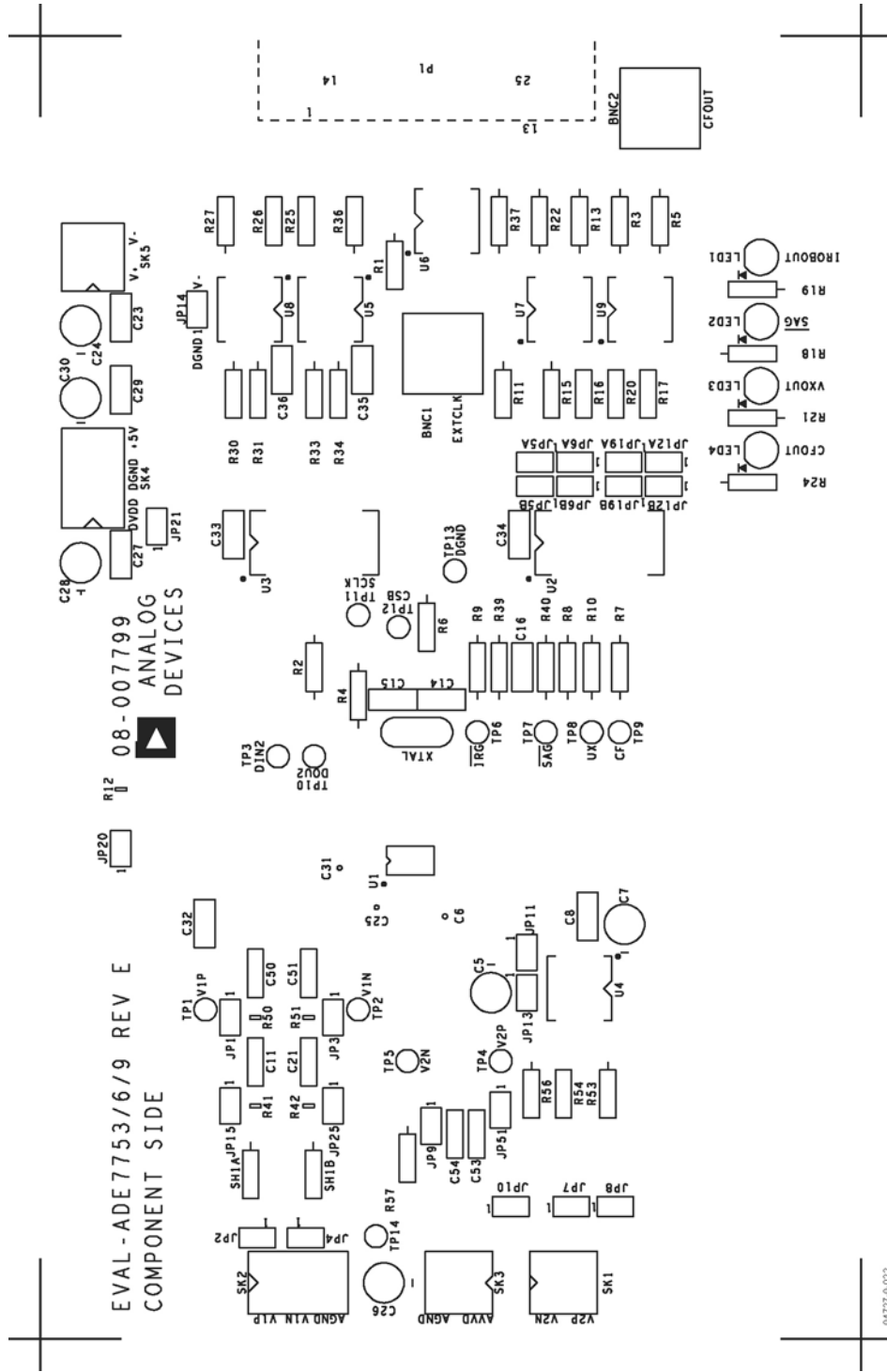


Figure 18. PCB Layout—Component Placement

PCB LAYOUT—COMPONENT SIDE (REV. E)

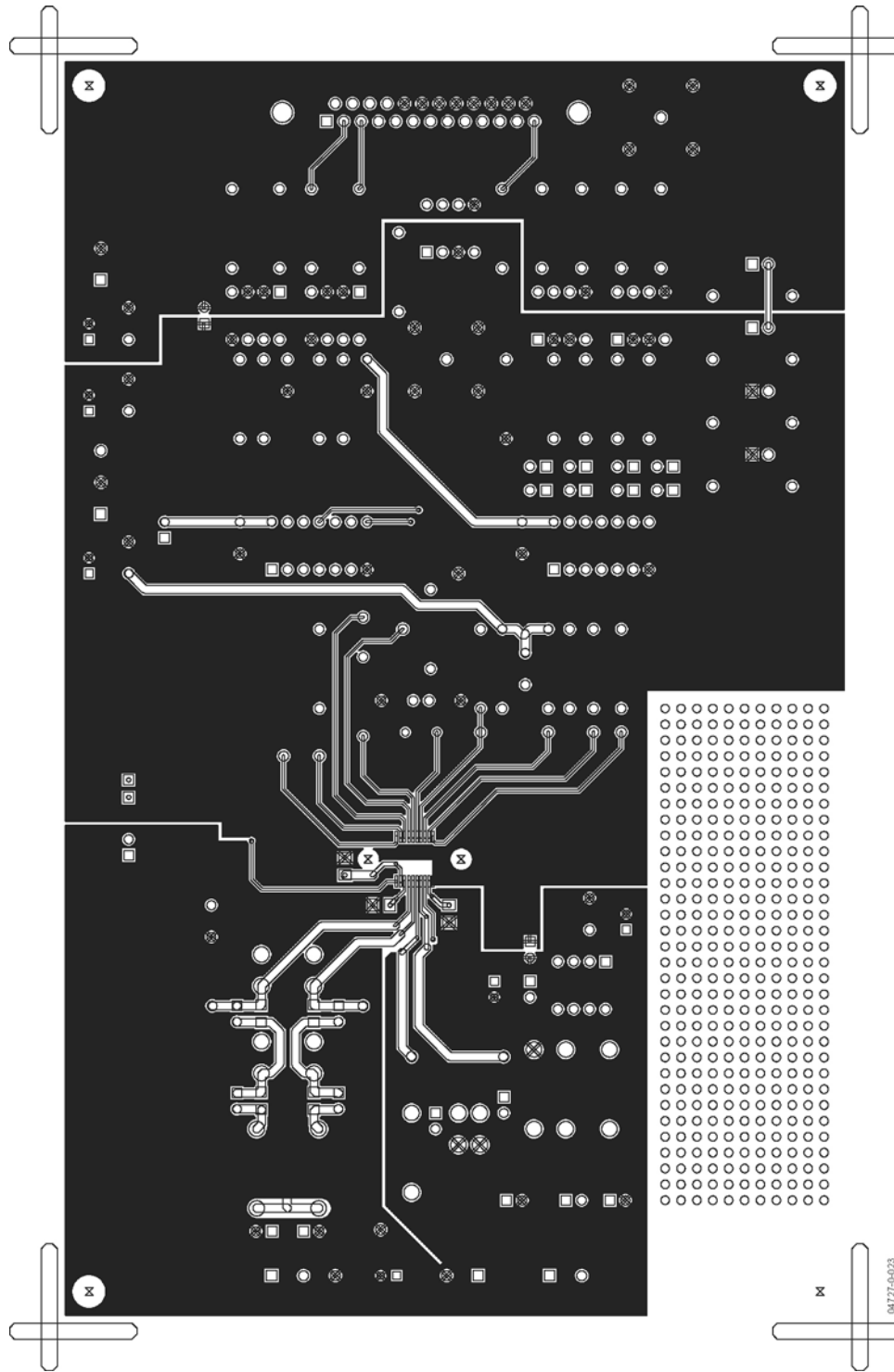


Figure 19. PCB Layout—Component Side

PCB LAYOUT—SOLDER SIDE (REV. E)

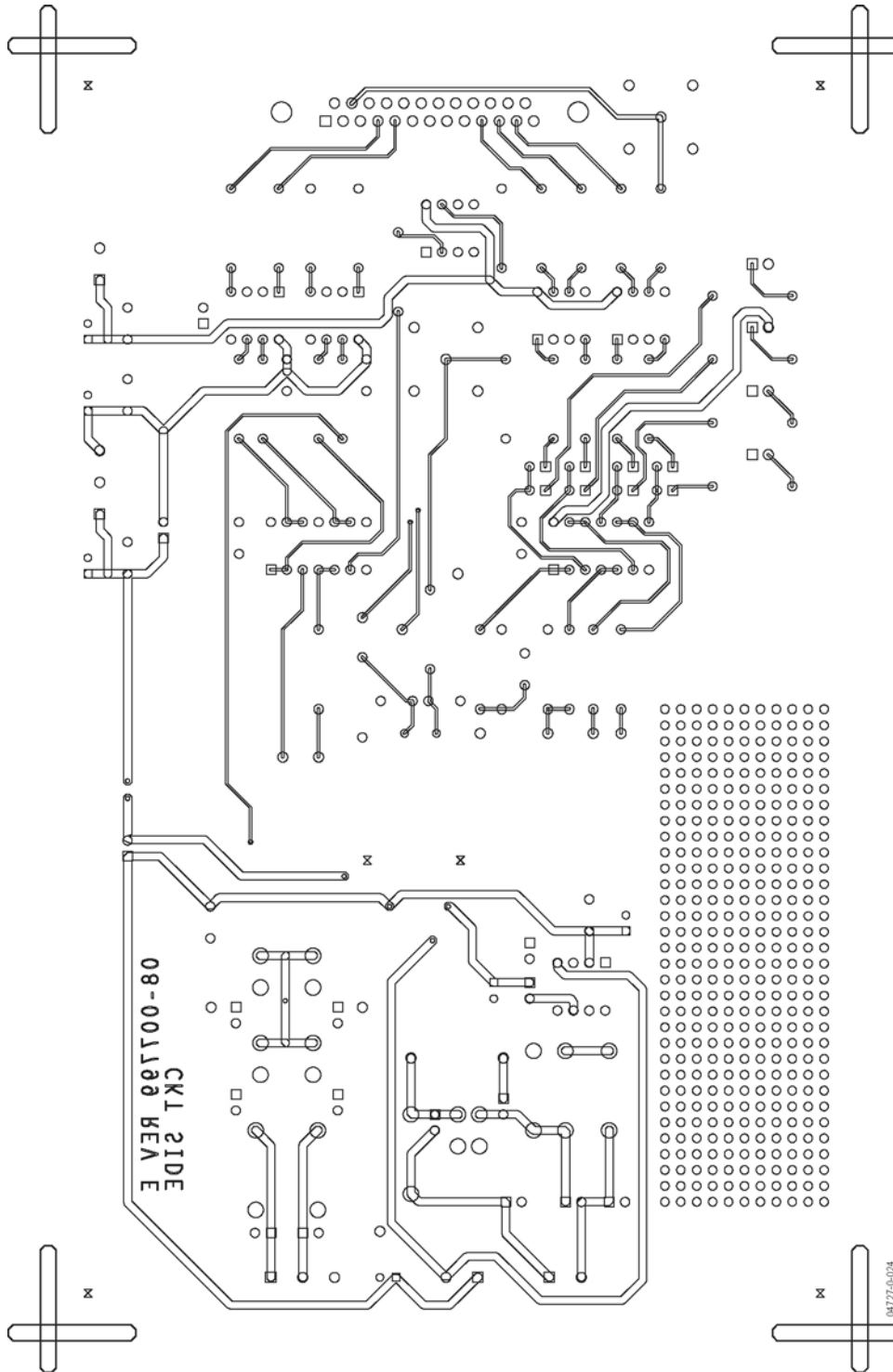


Figure 20. PCB Layout—Solder Side

RECOMMENDATIONS

The analog section of the system is sensitive to ground noise; therefore, users should select the setup of the evaluation board cautiously.

To obtain the best performances from the evaluation board, when it is used in a real meter configuration (Voltage = 220 V and the current sensor is connected), the configuration in Table 3 should be applied.

This setup requires three 5 V power supplies, an additional Ferrite Bead (Type Panasonic, EXCELSA391), and U2 to be disconnected.

If the CF pin is used to measure the accuracy of the system, the connection between the ADE7756's CF pin and the input of the opto-isolator should be restored by connecting U2.8 and U2.9 (see Figure 21).

Table 3. Evaluation Board Configuration

Jumper	Option	Comments
JP1	Open	
JP2	Open	
JP3	Open	
JP4	Closed	If Shunt Used
	Open	If CT Used
JP5 A	Open	
JP5 B	Open	
JP6 A	Open	
JP6 B	Open	
JP7	Open	
JP8	Open	
JP9	Open	
JP10	Closed	
JP11	Closed	Use Ferrite to Close Connection (Type Panasonic EXCELSA391)
JP12 A	Closed	
JP12 B	Open	
JP13	Open	
JP14	Open	
JP15	Closed	
JP19 A	Closed	
JP19 B	Open	
JP20	Closed	
JP21	Open	
JP25	Closed	
JP51	Closed	

EVAL-ADE7756EB

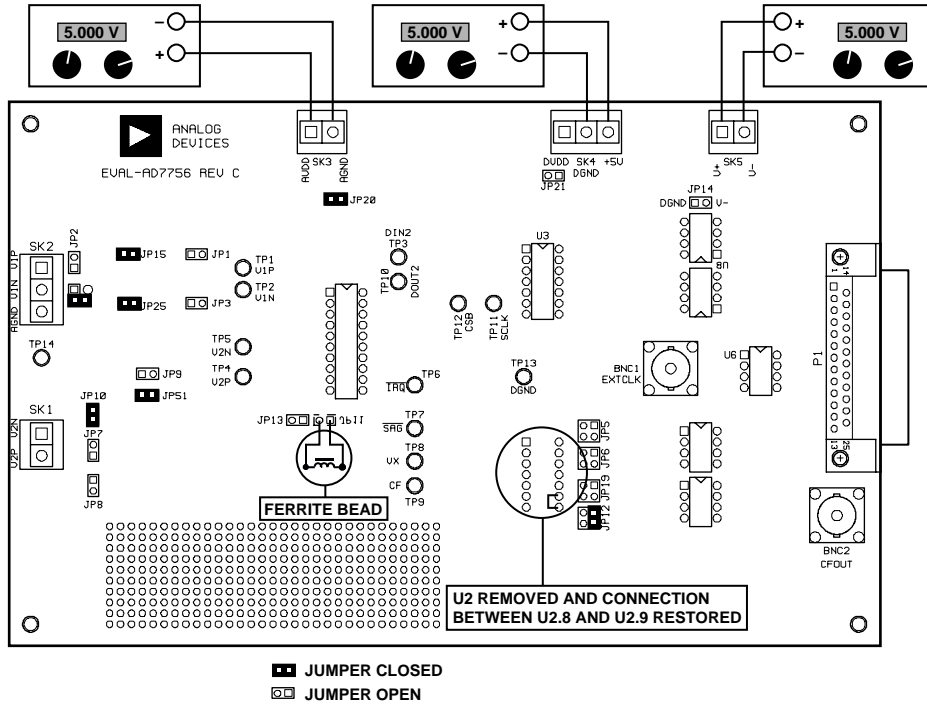


Figure 21. Evaluation Board Configuration

ORDERING GUIDE

Model	Description
EVAL-ADE7756EB	Evaluation Board